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SUBJECT: Stack Factors for the Graphite Reactor (3018) Stack

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FROM: J. F. Wett, Jr.

STACK FACTORS FOR THE GRAPHITE REACTOR (3018) STACK

This report presents the results of calculations of stack factors for the stack serving the Graphite Reactor. Calculations were made using correlations and data of Sutton and Holland as presented in AECU-3066 "Meteorology and Atomic Energy." The curves presented are not the result of a detailed meteorological study, but they are an attempt to present nominal values in as brief a manner as possible.

Stack factor will be defined as the concentration at ground level (curies-meters^{-3}) divided by emission rate from the stack (curies-sec^{-1}). The dimensions of the stack factor are thus, sec-meters^{-3}. The maximum stack factor for a continuous source, i.e., the factor which gives the maximum ground concentration for a given emission rate is given as

$$S.F._{max} = \frac{2}{e \pi \bar{u} h^2}$$

where the symbols are defined in "Terminology." The height of the 3018 stack is 200 feet.

The momentum of the gas flowing up the stack fictitiously augments the height of the stack by a certain amount. If the gas flowing in the stack is heated, another fictitious augmentation will occur. The pseudo Δh is given by the formula

$$\Delta h = \frac{1.5\, V_s d + 3 \times 10^{-4}\, Q_H}{u}$$

The diameter of the 3018 stack is 5.75 feet. At full air flow and full reactor power V_s is 45 mph and Q_H is 8.3×10^5 cal/sec. When the reactor is shut down, the fans are dampered to the position where V_s is about 22 mph; and since the reactor is not operating, Q_H is zero.

Figure 1 shows stack factor for various wind speeds given in miles per hour. Curves are shown for no buoyancy or momentum augmentation, for maximum operating conditions, and for half flow momentum augmentation but no buoyancy. It is seen that at extremely low wind speeds the buoyancy is quite effective.

The base of the 3018 stack is 60 feet above the elevation of Central Avenue. If 60 feet is added to the stack height, a new stack factor is found. Such factors are shown in Figure 2.

The correlation for stack factor as a function of distance from the source is

$$S.F. = \frac{2}{c^2 \bar{u} x^{2-n}} e^{\left[-\frac{h^2}{c^2 x^{2-n}}\right]}$$

The solutions for an unaugmented stack as a function of wind speed are shown in Figure 3.

The distance from the source to the maximum concentration is given by

$$D_{max} = \left[\frac{h^2}{c^2}\right]^{\frac{1}{2-n}}$$

Solutions for various atmospheric conditions are shown in Figure 4.

NOMENCLATURE

$S.F._{max}$	maximum stack factor (sec/meter^3)
S. F.	stack factor
$\bar{u}$	wind speed (meter/sec)
h	stack height (meter)
V_s	gas speed (miles per hour)
u	wind speed (miles per hour)
Q_H	heat leaving stack (cal per sec)
c	Sutton pseudo diffusion constant
x	distance down wind from source
d	diameter of stack (feet)
D_{max}	distance from maximum concentration to source (meters)
n	constant relating to atmospheric stability

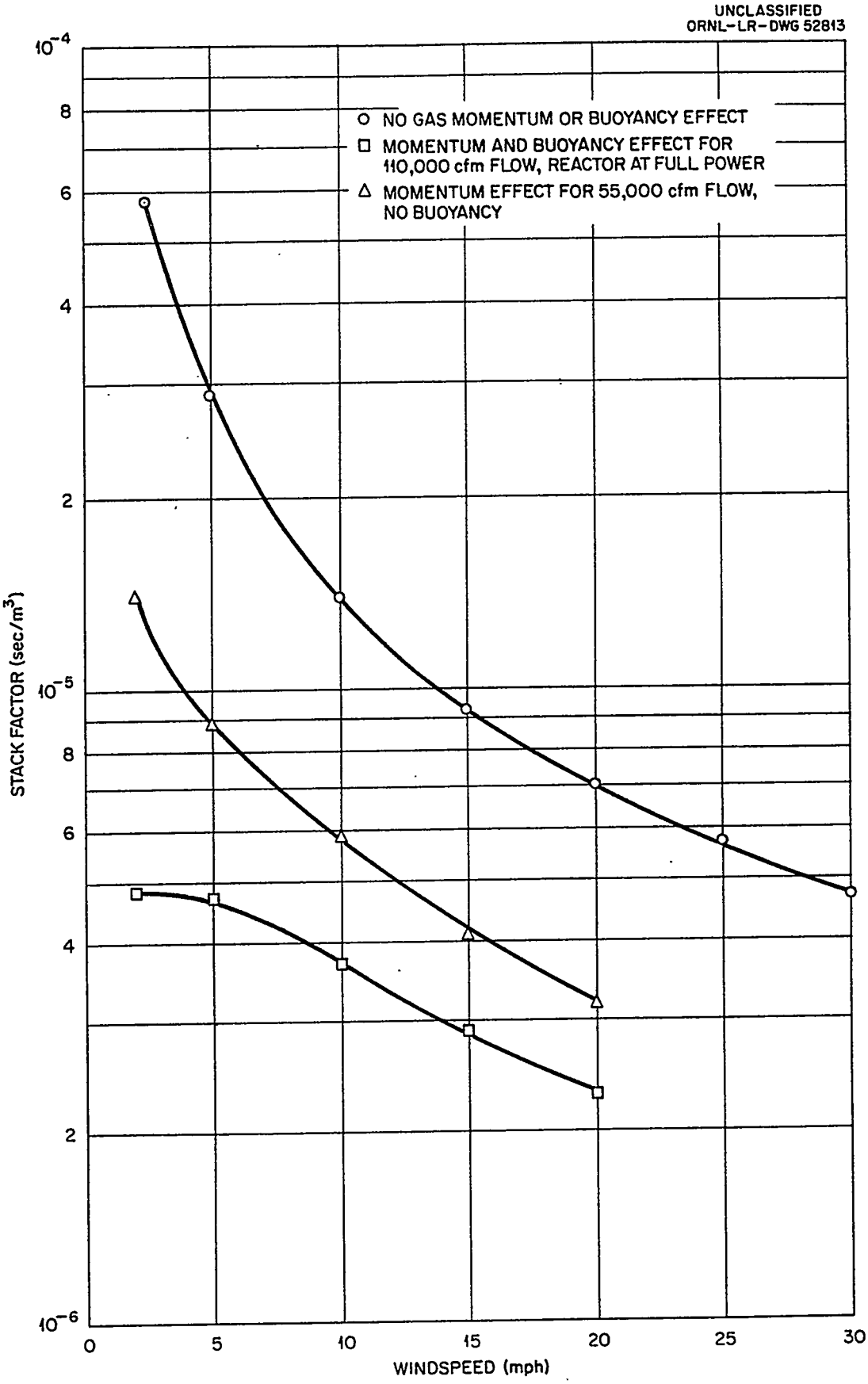

Fig. 1. Maximum Stack Factor for Graphite Reactor Stack Assuming Stack is on Table Land.

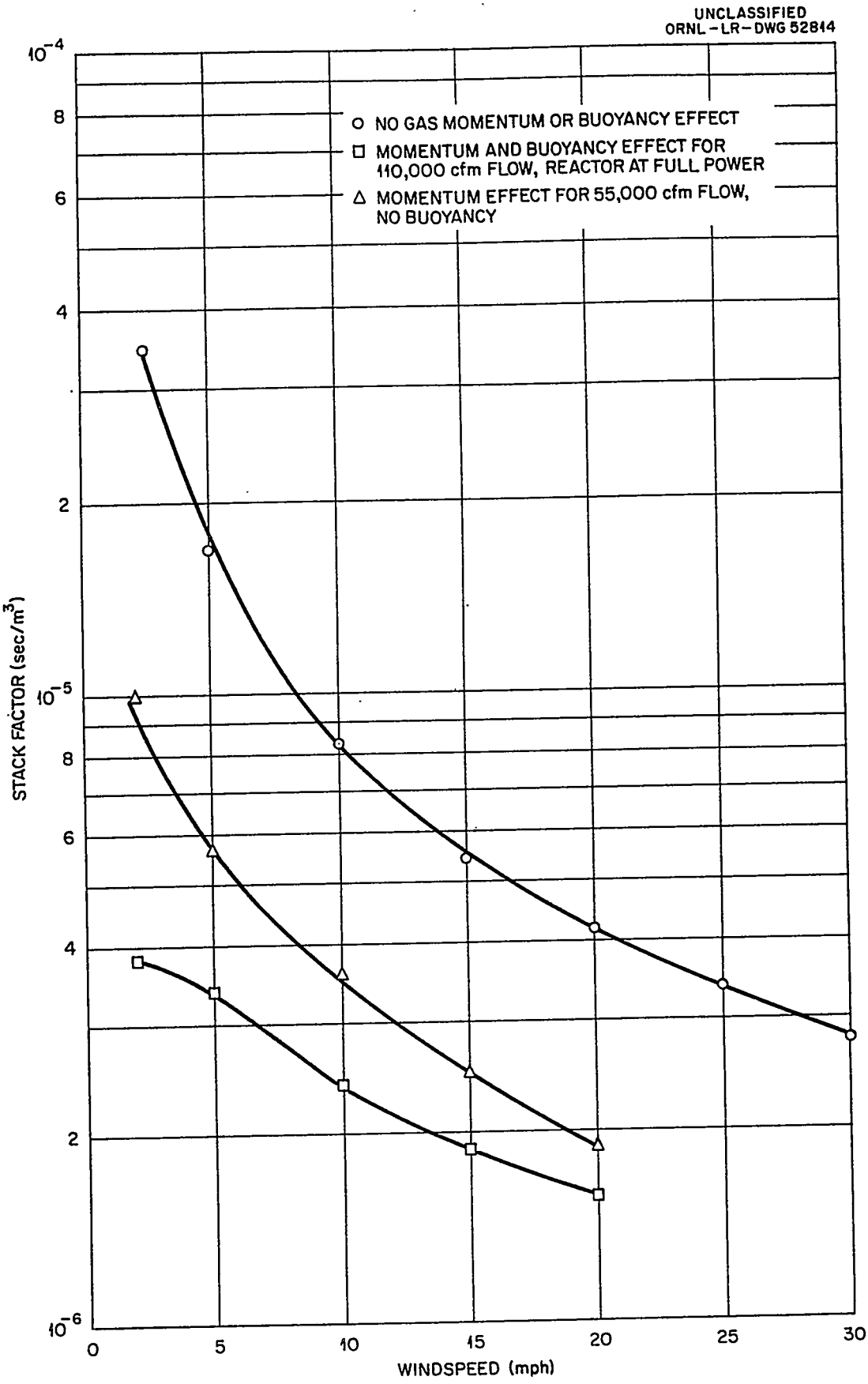

Fig. 2. Maximum Stack Factor for Graphite Reactor Stack, Base of Stack is 60 ft above Central Ave.

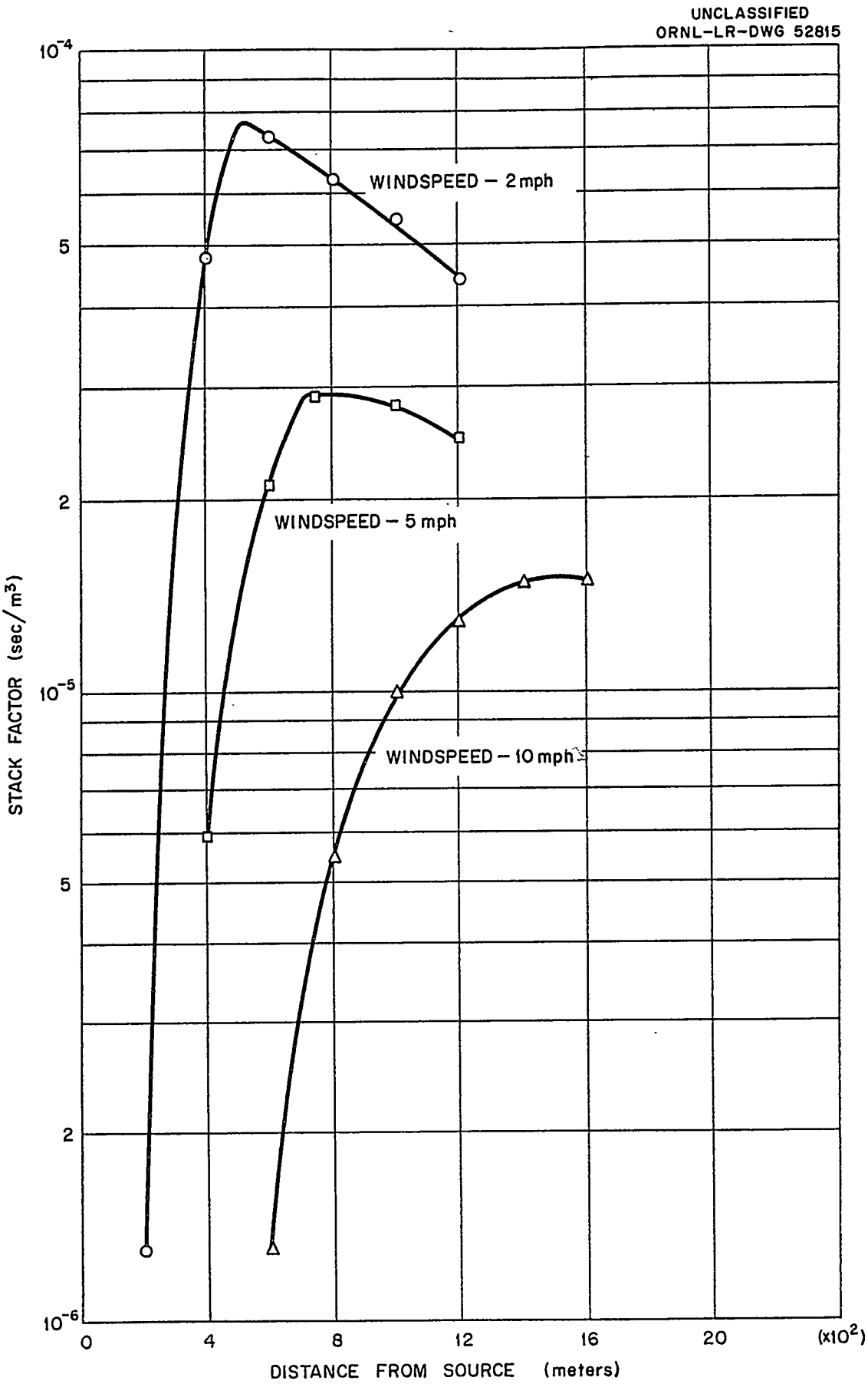

Fig. 3. Stack Factor for Graphite Reactor Stack Neutral Atmospheric Conditions. (Condition of Fig. 1 – no Momentum or Buoyancy)

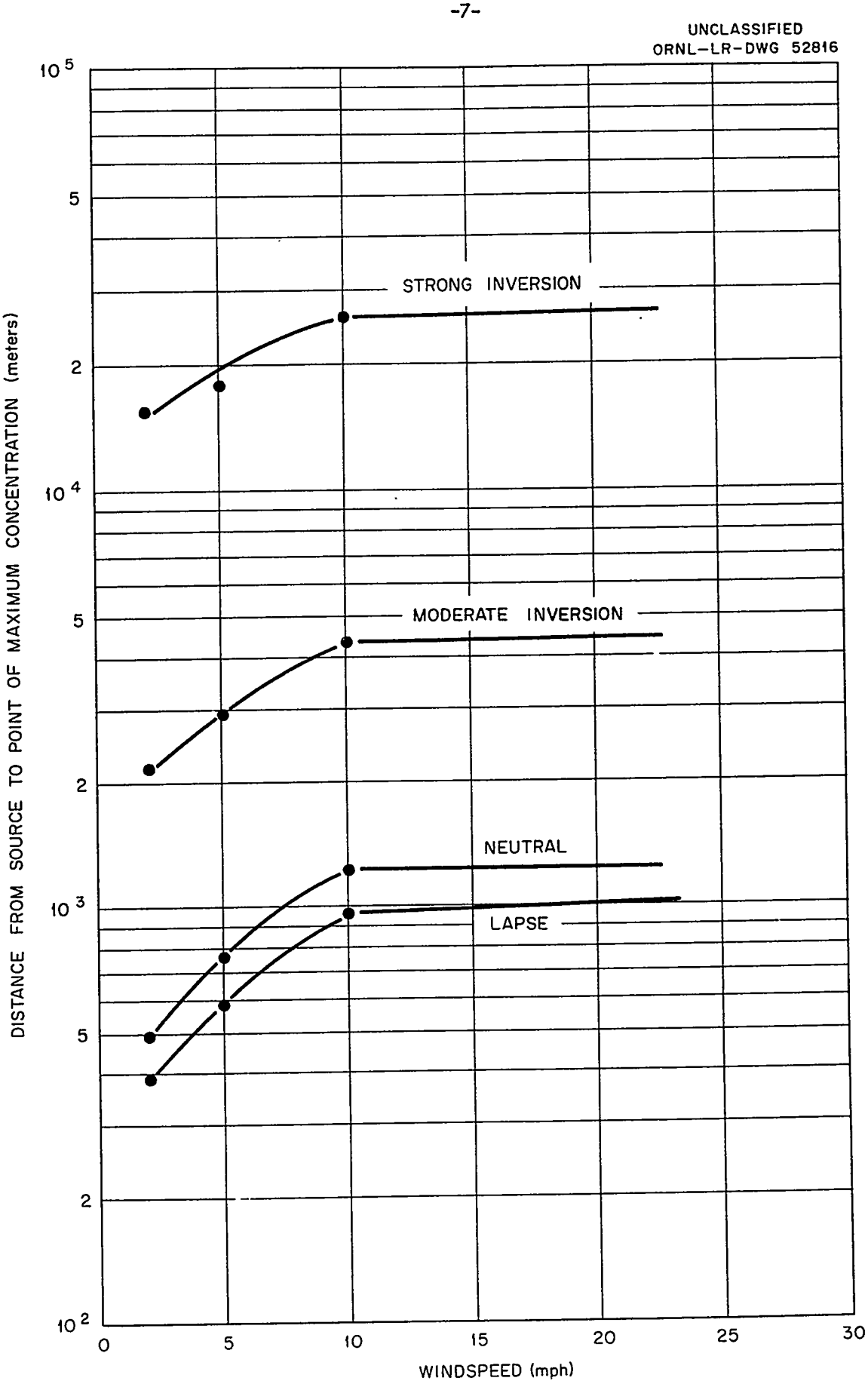

Fig. 4. Point of Maximum Concentration for Various Atmospheric Conditions.

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